

GAO

Report to Congressional Requesters

July 31, 1986

DOD ACQUISITION

Case Study of the Air Force Space Based Space Surveillance System



Preface

The Committee on Senate Committee on Governmental Affairs and its Subcommittee on Oversight of Government Management asked GAO to evaluate the capabilities of the program manager and contractor under its weapon systems acquisition. As part of this study, we evaluated 17 key present weapons system programs with individual cases of development. These case studies document the history of the programs and their funding information for informational purposes.

This study of the Space-Based Space Surveillance Program focuses on the role of the program manager and contracting officer in developing the acquisition strategy. Contractors' bid recommendations can be found in our final report, *Acquisition Strategy: Capabilities of Key Defense Systems Acquisition Programs*, GAO-94-1058, 15 May 1994.

Bill J. McNamee
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Space Based Space Surveillance System

Origin of the Program

Two types of space surveillance data is required to detect, track, identify, and assess the effects of man-made objects in a satellite or orbital debris state:

- determine the size of objects put into orbit by other nations;
- identify their orbits; and
- determine the space object's motion.

With this information actions can be taken to protect U.S. satellites from attack or to detect attacks on other satellites should they occur. The purpose of the Space-based Space Surveillance (SSS) Program, defined in March 1984, was to develop a survivable system capable of providing surveillance of space activities and timely information on the activities to the appropriate agencies.

The SSS Program had its origins in conceptual studies begun in the early 1970s. At that time it was recognized that objects in space could represent significant perils to our national defense. We began to evaluate the issue in the next two decades.

In December 1976, the Space Initiatives Service Program and the early phases of the SSS Program were initiated. The primary function of the program was to provide a report of concept demonstration for a long range orbital sensor system. The review is to validate the feasibility of the concept and demonstrate a system that can be deployed and tested in space and the space environment. It is proposed that the first detector that provides both the detection capability and surveillance capability be built by 1990. Although SSS is not yet a reality,

the initial concept report was accepted in May 1977. The Space Initiatives Service Program was terminated in late 1980. The SSS program continued, however, and was joined with the National Defense Science and Engineering Graduate School to develop the orbital sensor system. The concept report was submitted to the Office of Defense Research and Engineering, Defense Science Board, National Defense Science and Engineering Graduate School, and the Defense Science Board Graduate Research Staff.

Following the initial concept report, several efforts were conducted to further develop the concept. The development of the SSS Program, the Space-based Space Surveillance System, involved the Center for Naval Analyses, the Defense Science Board Graduate Research Staff, the Defense Science Study, and

Background Measurements Program provided data on various backgrounds that targets must be viewed against. The Air Force Space Technology Center investigated ten different technology areas relevant to space surveillance. These included:

- long-life cryogenics,
- long-wave infrared focal plane arrays,
- data processing,
- long-wave infrared optics design analysis.

The Architecture Study identified both near and far term requirements for space surveillance in seven mission categories:

Formation of the Program Office

The program manager for this was appointed in February 1989 as head of the Directorate of Space Surveillance and Command of Systems. This office was part of the newly formed program office which incorporated several separate organizations. The program manager was responsible for ground and space-based space surveillance systems. Before the formal start of the program, a contractor office was also designated. The program manager had approximately 16 years experience in a technical mission element. He worked approximately 7 years as a test engineer, 7 years as a program manager, and 2 years as a management consultant.

The Air Force sponsored the United States Space Surveillance Architecture Study from January to December 1989. Individuals from throughout the Department of Defense and by contractors participated in working groups to identify current surveillance systems, compare their performance requirements, identify key planned surveillance system alternatives, and analyze the results to determine the best set of new sensors to meet the requirements. The US program manager participated in the Space Surveillance Architecture Study of requirements, both near and far term.

The new was identified in the Space Surveillance Architecture Study as the most effective approach to satisfy IV of the majority of the requirements.

In May 1990, an Air Force memorandum of Mission Need Statement was issued to the Air Force Space Surveillance and Command System. It presented to the Air Force requirements for the new system and related issues. After evaluation, it was determined that the new system approach was the most appropriate for the newly developed requirements. The program manager initiated the review and the program

needs statement to insure that the requirements were stated in a manner that allowed translation to system specifications and to understand mission needs.

Development of the Acquisition Strategy

According to the program manager, the original acquisition strategy, as developed by the program office, was three phased. The first phase was concept definition, the second was development of a prototype system, and the third was development of a second generation highly survivable system. Competition was planned only in phase I because the program manager did not believe funds would be available to carry competition into phase II. The program's acquisition strategy was presented and approved in a March 1983 Business Strategy Panel meeting chaired by the Air Force Systems Command Competition Advocate.

The acquisition strategy called for awarding two firm fixed price, level of effort contracts in phase I to define the approach to the program and identify the technology risks for phase II. Under phase II, a single award would be made to one of the phase I contractors on a fixed price incentive basis for the prototype system. The program office planned to release the request for proposals for phase I in November of 1983 and award contracts in calendar year 1984. A draft request for proposal was released to industry in March 1983. Industry comments on the draft were submitted in May 1983.

Phase I, the concept exploration phase, was expected to extend from January 1984 through December 1985, followed immediately by a Defense System Acquisition Review Council Milestone II review expected to result in the development of the prototype test in fiscal year 1987 through 1989.

The initial statement of work was developed primarily by the program manager, with input from his staff and the contracting officer. The statement of work was developed primarily by the program manager and his staff, and presented the specifications to be based on the requirements previously defined during the definition of the system and contractor's work. After being reviewed by the contracting officer, with inputs from the staff, the statement of work and conditions were reviewed and accepted by the program manager, staff, and key contractors for evaluation criteria.

¹ The Space-Based Space Surveillance System was originally proposed as a joint program between the Air Force and the Defense Department. The Defense Department withdrew its participation in 1981.

jointly developed by the program manager and contracting officer. The DSS request for proposal was reviewed for consistency with the acquisition plan by both the program manager and the contracting officer.

Source Selection Started

The source selection plan was completed September 20, 1983, and a source selection board was established. The DSS source selection plan was developed jointly by the program manager and the original contracting officer. The original contracting officer, appointed in August 1983, stated he reviewed the source selection plan and compared it with previous source selection plans used at Space Division and determined it would accomplish the selection in accordance with regulations.

The DSS program manager and contracting officer jointly determined the contract type that would be appropriate for the concept definition phase of the system's development. They determined that firm fixed-price/level-of-effort contracts would be most appropriate.

Departure From the Acquisition Strategy

The Space program office developed a three-phase acquisition approach (concept definition, prototype system development, and development of a survivable system). In the August-November 1983 time frame, the program office altered this strategy to a two-phased approach.

Because of a budget cut and as more detailed cost estimates for the program were generated, the program manager concluded that a more cost effective approach was necessary. A two-phased approach was proposed by the second contracting officer. This approach envisioned the elimination of phase I (prototype system development) and proceeding directly to phase II (development of a second generation survivable system).

The decision to go directly to a survivable system, thus saving the cost of developing a non-survivable prototype system in phase II, was based on an assessment of the nature of risks. The program manager believed the contractors would not have to validate any new technology and that they would be able to build assy into without great technical risk; therefore the validation phase would not be necessary. Validation that was to be done in phase II had, according to the program manager, already been done in other research and development projects.

Funding Levels

SSTSS funding levels, as reflected in the fiscal year 1985-89 program objective memorandum, were inadequate to implement the original acquisition strategy. The SSTSS system concept which was adopted was based on the findings of the 1982 Air Force Space Surveillance Architecture Study and subsequent analyses conducted by Space Command and Space Division. The funding requested in the program objective memorandum, on the other hand, was based on a concept developed by a contractual study conducted from 1979 to 1981.

The 1982 Air Force Space Surveillance Architecture Study and its follow-on efforts were conducted to identify and develop a fully operational space surveillance system in the near term. The 1979 to 1981 contractual study, however, was performed primarily to demonstrate the credibility of long wave infrared technology for the Space Infrared Sensor Program, and to develop a SSTSS baseline system concept to meet the mission performance objectives. This original concept called for a system with significantly less durability, survivability, and operational capability than envisioned in the SES concept as of July 1983.

An Air Force Audit Agency report, dated November 25, 1983, reviewed the original acquisition strategy and found it posed technological risks and a highly concurrent, success-oriented schedule that could result in schedule slips and cost increases. The Air Force audit report also reported that sufficient funds might not be available to insure SSTSS program stability and progress because the funding requested in the Air Force fiscal years 1985-89 program objective memorandum was not consistent with the July 1983 SES system concept and contracting strategy. Funding levels were based on a system concept that called for significantly less durability, survivability, and operational capability than envisioned in the SES concept as of July 1983. The Air Force Audit Agency reported that the \$20 million (then year dollars) requested in the Air Force FY 1985-87 program objective memorandum may have been as much as \$1 billion (then year dollars) short of funding required to support the SSTSS program.

Impact of the Strategic Defense Initiative

A change of emphasis in national policy shifted the direction of the SES program. On March 23, 1983, President Reagan delivered a speech in which he called for a long-term research and development program to begin to achieve our intermediate goal of eliminating the threat posed by strategic nuclear missiles. Subsequently, DOD established the Deterrent Technologies Study Team and the Future Strategic Strategy Study Team to assess the technical and policy issues of a ballistic missile defense.

system. In January 1984, the Strategic Defense Initiative Research Program was established.

The first phase I request for proposal was scheduled to be released as soon as top Air Force management approval was obtained. However, management approval was held back at the Office of the Assistant Secretary of the Air Force because of funding limitations and concern that the program was not fully integrated with the Strategic Defense Initiative. Although attempts were made to synchronize the SDI with the Strategic Defense Initiative, the Deputy for Strategic Systems considered these attempts a marginal response to the Strategic Defense Initiative's surveillance, acquisition, track and assessment program element plans and technology objectives. On March 28, 1984, the Deputy for Strategic Systems denied approval for release of the request for proposal.

Evaluation of Role and Acquisition Strategy

Roles and Responsibilities

The program manager had a lead role in developing the original three-phased acquisition strategy while the first contracting officer acted as an influential advisor. The program manager later changed the strategy to a two-phased strategy as suggested by the second contracting officer.

The acquisition strategy was approved through the various review levels of the Air Force until it reached the Office of the Assistant Secretary of the Air Force where the program was deferred due to budgetary and other reasons.

Design Competition

Directive 7000.1 encourages competitive design work up to full-scale development or beyond if cost effective. Air Force Systems Command policy is to compete programs up to critical design review (an advanced stage in full-scale development) and preferably through full-scale development. However, the Air Force declined to enter competition for the X-30s only through concept definition.

Curtailment of competition at this point may have been premature given the technological risks involved in the program. Technologies for the X-30 (proton reactor, fuel plant, oxygenated artificial processor) had not

been fully proven or demonstrated. The Deputy Assistant Secretary of the Air Force (Space Plans and Policy) expressed concern that the Air Force might be trying to develop the needed technology at the same time as it was proceeding with contractor selection for system development. He expressed the view that the Air Force should not commit to full-scale development or overspend on concept definition until the required technology was available and stated that if the technology was not satisfactorily developed and demonstrated, production, components, and subsystems might require modification, schedule increases, or cost overruns.

The Production Competition

Due to the limited number of STSS satellites to be acquired, competition was not planned for the production phase of the program.

External influences

The program manager's perception of the operating environment limited the amount of competition which was included in the original acquisition strategy. In assessing the amount of funds that would likely be available to implement the strategy, he concluded that funds would not likely be available to carry competition past the first phase of the program.

Present Status

The STSS program was deferred because of budgetary and other concerns in March 1984.

Chronology of Events

Fiscal Year 1976	Space Infrared Sensor Program initiated.
February 1980	Program manager appointed.
May 1982	Space Infrared Sensor Program terminated. Direction to proceed with development of a prototype space satellite issued.
January-October 1982	Space Surveillance Architecture Study conducted.
July 1982	SSIS Justification for Major System New Start approved.
January 1983	Space Division Business Strategy Panel reviews acquisition strategy.
March 1983	Draft request for proposal issued. Air Force Systems Command Business Strategy Panel approves acquisition strategy. President announces strategic defense initiative.
April 1983	Acquisition strategy formalized.
June 1983	Request for proposal scheduled for approval.
August 1983	Solicitation Review Panel convenes. Request for proposal scheduled for release. Second contracting officer appointed.

August-November 1983	Changes made to acquisition strategy.
September 1983	Source selection plan completed.
October 1983	Source Selection Board scheduled to be established.
November 1983	Air Force audit report issued.
January 1984	Strategic Defense Initiative Program established.
March 1984	Decision made to defer acquisition of SSS.

TRANSCRIBED PAGES FOLLOW

The Chairmen of the Senate Committee on Governmental Affairs and its Subcommittee on Oversight of Government Management asked GAO to examine the capabilities of the program manager and contracting officer in weapon systems acquisition. As part of this study, GAO examined 17 new major weapon system programs in their initial stages of development. These case studies document the history of the programs and are being made available for informational purposes.

This study of the Space Based Space Surveillance Program focuses on the role of the program manager and contracting officer in developing the acquisition strategy. Conclusions and recommendations can be found in our overall report, DOD Acquisition: Strengthening Capabilities of Key Personnel in Systems Acquisition (GAO/NSIAD-86-45, May 12, 1986).

[signed "Bill W. Thurman for"]

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The purpose of space surveillance is to detect, track, identify, and assess space objects of all kinds, especially satellites and antisatellite interceptors. Through space surveillance the United States can:

- determine the place of objects put into orbit by other nations,
- identify their orbits, and
- determine the space object's mission.

With this information, actions can be taken to protect U.S. satellites from attack or initiate attacks against enemy satellites should the need arise. The purpose of the Space Based Space Surveillance (SBSS) Program, deferred in March 1984, was to develop a survivable system capable of providing surveillance of space activities and timely information on those activities to the appropriate agencies.

The SBSS Program had its origin in conceptual studies begun in the early 1970's. At that time, it was recognized that objects in space (resident space object population), both foreign and domestic, would increase dramatically in the next two decades.

In fiscal year 1976, the Space Infrared Sensor Program and the early phases of the SBSS Program were initiated. The Space Infrared Sensor Program was to provide a proof of concept demonstration for a long wave infrared sensor system. The SBSS was to address the definition, design, and acquisition of a system employing more advanced technology than the Space Infrared Sensor Program. During its conceptual phase, SBSS had been referred to as Deep Space Surveillance Satellite or Low Altitude Surveillance Satellite.

According to a program management directive issued in May 1982, the Space Infrared Sensor Program was to be terminated and the Air Force Systems Command, "shall proceed with preliminary design and development of a prototype SBSS satellite based on LWIR [long wave infrared] technology." In July 1982, a Justification for Major System New Start for space surveillance was approved by the Defense Resources Board as a fiscal year 1984 new start.

During the 1976-82 time period, a number of parallel efforts were ongoing in support of SBSS, including: (1) the Background Measurements Program, (2) technology programs under the Air Force Space Technology Center (previously the Air Force Space Division Deputy for Technology), and (3) the Space Surveillance Architecture Study. The

Background Measurements Program provided data on various backgrounds that targets must be viewed against. The Air Force Space Technology Center investigated four critical technology areas relevant to SBSS. These included:

- long life cryogenic coolers,
- long wave infrared focal plane arrays,
- data processing, and
- long wave infrared optics design/analysis.

The Architecture Study identified both near and far term requirements for space surveillance in seven mission categories.

The program manager for SBSS was appointed in February 1980 as head of the Directorate of Surveillance and Command Systems. This office was part of the Space Defense program office, which incorporated several separate program offices. The program manager was responsible for ground and space-based space surveillance systems. Before the formal start of the program, a contracting officer was also designated. The program manager had approximately 16 years experience in acquisition management. He worked approximately 7 years as a test engineer, 7 years as a program manager, and 2 years as a management consultant.

The Air Force sponsored the 1982 Space Surveillance Architecture Study from January through October 1982. Individuals from throughout The Department of Defense (DOD) and key contractors participated in working groups to identify current surveillance sensor systems, define all possible surveillance requirements, identify all practical surveillance sensor alternatives, and analyze the results to determine the best set of new sensors to meet the requirements. The SBSS program manager participated in the Space Surveillance Architecture Study of requirements, both near and far term.

The SBSS was identified, in the Space Surveillance Architecture Study, as the most effective approach to satisfy the majority of the requirements.

In May 1982, an Air Force space surveillance Mission Element Need Statement was incorporated into a Justification of Major System New Start and presented to the Defense Resources Board. The SBSS system was identified as an Air Force major system fiscal year 1984 new start in a program decision memorandum signed by the Deputy Secretary of Defense. The program manager indicated that he reviewed the mission

needs statement to insure that the requirements were stated in a manner that allowed translation to system specifications and to understand mission needs.

According to the program manager, the original SBSS acquisition strategy, as developed by the program office, was three-phased. The first phase was concept definition, the second phase was development of a prototype system, and the third was development of a second generation highly survivable system. Competition was planned only in phase I because the program manager did not believe funds would be available to carry competition into phase II. The program's acquisition strategy was presented and approved in a March 1983 Business Strategy Panel meeting chaired by the Air Force Systems Command Competition Advocate.

The acquisition strategy called for awarding two firm fixed-price, level of effort contracts in phase I to define the approach to the program and identify the technology risks for phase II¹. Under phase II, a single award would be made to one of the phase I contractors on a fixed-price incentive basis for the prototype system. The program office planned to release the request for proposals for phase I in November of 1983 and award contracts in calendar year 1984. A draft request for proposal was released to industry in March 1983. Industry comments on the draft were submitted in May 1983.

Phase I, the concept exploration phase, was expected to extend from fiscal years 1984 through 1986, followed immediately by a Defense Systems Acquisition Review Council Milestone II review expected to result in the development of the prototype from fiscal year 1987 through 1990.

The SBSS statement of work was developed primarily by the program manager with input from his staff and the contracting officer. The SBSS specifications were developed primarily by the program manager and his engineering personnel; the specifications were based on the requirements provided by the using command. Business terms and conditions were suggested by the contracting officer, with inputs from the staff. The business terms and conditions were reviewed and critiqued by the Space Division Solicitation Review Panel. Evaluation criteria were

¹Three contracts for phase I definition were originally considered to provide a wider range of options. However, due to funding constraints in fiscal years 1984 and 1985, this approach was abandoned.

jointly developed by the program manager and contracting officer. The SBSS request for proposal was reviewed for consistency with the acquisition plan by both the program manager and the contracting officer.

The source selection plan was completed September 20, 1983, and a source selection board was established. The SBSS source selection plan was developed jointly by the program manager and the original contracting officer. The second contracting officer, appointed in August 1983, stated he reviewed the source selection plan and compared it with previous source selection plans used at Space Division and determined it would accomplish the selection in accordance with regulations.

The SBSS program manager and contracting officer jointly determined the contract type that would be appropriate for the concept definition phase of the system's development. They determined that firm fixed-price level of effort contracts would be most appropriate.

The SBSS program office developed a three phase acquisition approach (concept definition, prototype system development, and development of a survivable system). In the August-November 1983 time frame, the program office altered this strategy to a two phased approach.

Because of a budget cut and as more detailed cost estimates for the program were generated, the program manager concluded that a more cost effective approach was necessary. A two-phased approach was proposed by the second contracting officer. This approach envisioned the elimination of phase II (prototype system development) and proceeding directly to phase III (development of a second-generation survivable system).

The decision to go directly to a survivable system, thus saving the cost of developing a nonsurvivable prototype system in phase II, was based on an assessment of technological risks. The program manager believed the contractors would not have to validate any new technology and that they would be able to build a satellite without great technological risk; therefore the validation phase would not be necessary. Validation that was to be done in phase II had, according to the program manager, already been done in other research and development projects.

SBSS funding levels, as reflected in the fiscal year 1985-89 program objective memorandum, were inadequate to implement the original acquisition strategy. The SBSS system concept which was adopted was based on the findings of the 1982 Air Force Space Surveillance Architecture Study and subsequent analyses conducted by Space Command and Space Division. The funding requested in the program objective memorandum, on the other hand, was based on a concept developed by a contractual study conducted from 1979 to 1981.

The 1982 Air Force Space Surveillance Architecture Study and its follow-on efforts were conducted to identify and develop a fully operational space surveillance system in the near term. The 1979 to 1981 contractual study, however, was performed primarily to demonstrate the capability of the long wave infrared technology for the Space Infrared Sensor Program, and to develop a SBSS baseline system concept to meet the mission performance objectives. This original concept called for a system with significantly less durability, survivability, and operational capability than envisioned in the SBSS concept as of July 1983.

An Air Force Audit Agency report, dated November 25, 1983, reviewed the original acquisition strategy and found it posed technological risks and a highly concurrent, success-oriented schedule that could result in schedule slips and cost increases. The Air Force audit report also reported that sufficient funds might not be available to insure SBSS program stability and progress because the funding requested in the Air Force fiscal years 1985-89 program objective memorandum was not consistent with the July 1983 SBSS system concept and contracting strategy. Funding levels were based on a system concept that called for significantly less in durability, survivability, and operational capability than envisioned in the SBSS concept as of July 1983. The Air Force Audit Agency reported that the \$800 million (then-year dollars) requested in the Air Force FY 1985-89 program objective memorandum may have been as much as \$1 billion (then-year dollars) short of funding required to support the SBSS program.

A change of emphasis in national policy shifted the direction of the SBSS program. On March 23, 1983, President Reagan delivered a speech in which he called for a "long-term research and development program to begin to achieve our ultimate goal of eliminating the threat posed by strategic nuclear missiles." Subsequently, DOD established the the Defensive Technologies Study Team and the Future Strategic Strategy Study Team to assess the technical and policy issues of a ballistic missile defense

system. In January 1984, the Strategic Defense Initiative Research Program was established.

The SBSS phase I request for proposal was scheduled to be released as soon as top Air Force management approval was obtained. However, management approval was held up at the Office of the Assistant Secretary of the Air Force because of funding limitations and concern that the program was not fully integrated with the Strategic Defense Initiative. Although attempts were made to reconcile SBSS with the Strategic Defense Initiative, the Deputy for Strategic Systems considered these attempts a marginal response to the Strategic Defense Initiative's surveillance, acquisition, track and kill assessment program element plans and technology objectives. On March 28, 1984, the Deputy for Strategic Systems denied approval for release of the request for proposal.

The program manager had a lead role in developing the original three-phased acquisition strategy while the first contracting officer acted as an influential advisor. The program manager later changed the strategy to a two-phased strategy as suggested by the second contracting officer.

The acquisition strategy was approved through the various review levels of the Air Force until it reached the Office of the Assistant Secretary of the Air Force where the program was deferred due to budgetary and other reasons.

DOD Directive 5000.1 encourages competitive design work up to full-scale development or beyond if cost effective. Air Force Systems Command policy is to compete programs up to critical design review (an advanced stage in full-scale development) and preferably through full-scale development. However, the Air Force planned to carry competition for the SBSS only through concept definition.

Curtailment of competition at this point may have been premature given the technological risks involved in the program. Technologies for the SBSS (cryogenic coder, focal plan, optics and signal processor) had not

been fully proven or demonstrated. The Deputy Assistant Secretary of the Air Force (Space Plans and Policy) expressed concern that the Air Force might be trying to develop the needed technology at the same time as it was proceeding with contractor selection for system development. He expressed the view that the Air Force should not commit to full-scale development or overspend on concept definition until the required technology was available and stated that if the technology was not satisfactorily developed and demonstrated, production, components, and subsystems might require modification, schedule increases, or cost overruns.

Due to the limited number of SBSS satellites to be acquired, competition was not planned for the production phase of the program.

The program manager's perception of the operating environment limited the amount of competition which was included in the original acquisition strategy. In assessing the amount of funds that would likely be available to implement the strategy, he concluded that funds would not likely be available to carry competition past the first phase of the program.

The SBSS program was deferred because of budgetary and other concerns in March of 1984.

Fiscal Year 1976	Space Infrared Sensor Program Initiated.
February 1980	Program manager appointed.
May 1982	Space Infrared Sensor Program terminated. Direction to proceed with development of a prototype SBSS satellite issued.
January-October 1982	Space Surveillance Architecture Study conducted.
July 1982	SBSS Justification for Major System New Start approved.
January 1983	Space Division Business Strategy Panel reviews acquisition strategy.
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